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DECLARATION

I, Won JEON, Korean Patent Attorney of 5F, Seil Building, 727-13, Yeoksam-dong, Gangnam-gu, Seoul, Korea do hereby solemnly and sincerely declare as follows:

1. That I am well acquainted with the English and Korean languages.
2. That the following is a correct translation into English of the accompanying certified copy of a Korean Patent Application No. 2003-19597.

and I make the solemn declaration conscientiously believing the same to be true.

Seoul, April 11, 2007

Won JEON

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This is to certify that annexed hereto is a true copy from the records of the Korean Industrial Property Office of the following application as filed.

Application Number : Patent Application No. 2003-19597

Date of Application : March 28, 2003

Applicant : Samsung Electronics Co., Ltd.

Dated this: April 15, 2003

COMMISSIONER

PATENT APPLICATION

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Title of the Invention : Liquid Crystal Display Apparatus And Method Of Manufacturing The Same

Dated this: March 28, 2003

To the COMMISSIONER

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[ABSTRACT]

[ABSTRACT]

In an LCD apparatus capable of improving display quality, the LCD apparatus includes a lower substrate, an upper substrate and a liquid crystal interposed between the lower and upper substrates. The lower substrate includes an auxiliary capacitor and a protecting layer having a contact hole that partially exposes the auxiliary capacitor. The upper substrate is combined with the lower substrate and includes a spacer disposed corresponding to the auxiliary capacitor so as to uniformly maintain a gap between the upper and lower substrates. Accordingly, the LCD apparatus may have an improved display quality.

[REPRESENTATIVE FIGURE]

FIG. 1

[SPECIFICATION]

[TITLE OF THE INVENTION]

LIQUID CRYSTAL DISPLAY APPARATUS AND METHOD OF MANUFACTURING THE SAME

[BRIEF EXPLANATION OF THE DRAWINGS]

FIG. 1 is a plan view showing a lower substrate of an LCD apparatus according to an exemplary embodiment of the present invention;

FIG. 2 is a cross-sectional view taken alone a line I-I' of a transmissive type LCD apparatus having the lower substrate shown in FIG. 1;

FIG. 3 is a cross-sectional view showing a transmissive type LCD apparatus according to another exemplary embodiment of the present invention; and

FIGS. 4A to 4F are views illustrating a method of manufacturing the LCD apparatus shown in FIG. 2.

<EXPLANATION ON CHIEF REFERENCE NUMERALS OF DRAWINGS >

100 : insulating substrate	110 : gate electrode
140 : first auxiliary electrode	210 : source electrode
370 : organic layer	410 : pixel electrode
2000 : LCD apparatus	810 : auxiliary capacitor contact hole

[DETAILED DESCRIPTION OF THE INVENTION]

[PURPOSE OF THE INVENTION]

[THE ART TO WHICH THE INVENTION PERTAINS AND THE PRIOR ART]

The present invention relates to an LCD (Liquid Crystal Display) apparatus and a method of manufacturing the same, and more particularly to an LCD apparatus having an improved display quality and a method of manufacturing the same.

In recently, touch screen technologies are widely applied to electronic instruments, for example, such as a PDA (Personal Digital Assistants), a mobile communication system and so on. In an LCD apparatus to which a touch screen panel is applied, a ripple phenomenon appears on an LCD panel of the LCD apparatus when a user touches a surface of the LCD panel. The ripple phenomenon is caused by swelling of a liquid crystal when the user locally and successively touches the surface of the LCD panel.

As one of methods in order to prevent the ripple phenomenon, a method that forms a column spacer inside the LCD panel so as to support the LCD panel touched by the user has been developed. However, since the column spacer presently used is uniformly distributed inside the LCD panel, the swelling of the liquid crystal may not be efficiently controlled. This is because the LCD panel may be variously deformed according to positions touched by the user even if the user touches the surface of the LCD apparatus at a uniform force.

The ripple phenomenon is caused rippling formed by compressing the LCD panel, depressing the LCD panel and continuously compressing and depressing the LCD panel.

Therefore, when an area of the column spacer in a unit pixel is increased, the ripple phenomenon is minimized.

However, when the area of the spacer is increased more than a predetermined area, the ripple phenomenon is not decreased less than a predetermined amount.

[TECHNICAL OBJECT OF THE INVENTION]

The present invention provides an LCD apparatus having an improved display quality.

The present invention provides a method suitable for manufacturing the above LCD apparatus.

[CONTRUCTION AND OPERATION OF THE INVENTION]

In one aspect of the invention, an LCD apparatus includes a lower substrate, an upper substrate, a spacer and a liquid crystal.

The lower substrate includes an insulating substrate, a gate line, an auxiliary capacitor, a protecting layer, a gate line extended in a first direction on the insulating substrate, a data line, an auxiliary capacitor contact hole and a pixel electrode. A gate line is branched from the gate line.

The auxiliary capacitor includes a gate insulating layer covering the gate line, a first auxiliary electrode and a second auxiliary electrode. The first and second auxiliary electrodes are spaced apart from each other by the gate insulating layer to function as the auxiliary capacitor. The protecting layer covers the auxiliary capacitor.

The auxiliary contact hole is formed through the protecting layer to expose the second auxiliary electrode. The pixel electrode is formed on the protecting layer to electrically connect the drain electrode with the second auxiliary electrode.

The spacer is formed on the upper substrate corresponding to the auxiliary contact hole. The lower substrate is spaced apart from the upper substrate at a constant distance by the spacer.

Hereinafter, the present invention will be described in detail with reference to the accompanying drawings.

FIG. 1 is a plan view showing a lower substrate of an LCD apparatus according to an exemplary embodiment of the present invention. FIG. 2 is a cross-sectional view taken alone a line I-I' of a transmissive type LCD apparatus having the lower substrate shown in FIG. 1.

Referring to FIGS. 1 and 2, the lower substrate 1000 includes a gate line 131 and an auxiliary electrode line 145 including aluminum (Al), aluminum alloy, molybdenum (Mo), molybdenum-tungsten alloy (MoW), chromium (Cr) and tantalum (Ta).

In FIGS. 1 and 2, an auxiliary capacitor is formed through a previous gate method. In the previous gate method, a previous gate pattern that is adjacent to the gate line 131 functions as a first auxiliary electrode 140, and the data line 230a is branched to form a

second auxiliary electrode 230b. Thus, the first and second auxiliary electrodes 140 and 230b function as the auxiliary capacitor.

The first and second auxiliary electrodes 140 and 230b interpose the gate insulating layer 170 to function as the auxiliary capacitor that stores an electric charge. Thus, capacitance of a liquid crystal capacitor is compensated by the auxiliary capacitor.

A gate pattern 131, 110 includes the gate line 131 extended in the first direction and a gate electrode 110 that is from the gate line 131. A plurality of gate electrodes 110 may be spaced apart from each other. The auxiliary capacitor 145 receives an externally provided voltage such as a common voltage of an upper substrate, and is overlapped with a pixel electrode or a conductive pattern for the auxiliary capacitor.

The gate pattern 131 and 110 and the auxiliary electrode line 145 may be provided with a single layer, a double layer or a triple layer. In case that the gate pattern is provided with the double or triple layers, one layer includes the chromium (Cr) or the aluminum (Al) and another layer includes the aluminum (Al) or the molybdenum (Mo).

A gate insulating layer 170 is formed over the insulating substrate 100 comprising a silicon nitride (SiN_X) on which the gate pattern is formed.

A semiconductor layer 320 and an active layer 330 of an island type are successively formed on the gate insulating layer 170 corresponding to the gate electrode 110.

A conductive metal layer formed on the gate insulating layer 170 on which the semiconductor layer 320 is formed is patterned to form a data line 230a extended in a second direction different from the first direction, source-drain electrodes 210 and 310 protruded from the data line 230a and partially overlapped with the active layer 330.

The gate electrode 110, the active layer 330 and the source-drain electrodes 210 and 310 are partially overlapped, and the data line 230a is substantially perpendicular to the gate line 230b when viewed on a rear surface of the insulating substrate 100.

A portion of the source-drain electrodes 210 and 310 overlapped with the gate

electrode 110 is etched to form a source electrode 210 and a drain electrode 310. Thus, a thin film transistor is completed. The source electrode 210 is electrically connected to the data line 230a, and the source electrode 210 is spaced apart from the drain electrode 310.

An organic layer 370 including a benzocyclobutene (BCB), an acrylic resin, etc., is formed over the insulating substrate 100 on which the source electrode 210 and the drain electrode 310 are formed. The organic layer 370 is patterned through a photolithography process, so that a drain contact hole 710 and an auxiliary contact hole 810 are formed through at the organic layer 370. The drain contact hole 710 partially exposes the drain electrode 310. The auxiliary contact hole 810 partially exposes the auxiliary electrode.

The pixel electrode 410 is formed on the drain electrode and the organic layer 370 having the drain contact hole 710 and the auxiliary contact hole 810. The pixel electrode 410 corresponding to the data line 230a is partially etched to be electrically insulated from a pixel electrode in an adjacent pixel region.

The pixel electrode 410 applies a voltage to a liquid crystal layer 400 sealed between the upper substrate 200 combines with the lower substrate 5000 and the lower substrate 5000. The pixel electrode 410 includes a transparent conductive material, for example, such as an indium tin oxide (hereinafter, referred to as ITO), so as to transmit a light provided from a lower portion of the lower substrate 1000.

When the upper substrate 200 is combined with the lower substrate 5000, a spacer is used to maintain a cell gap. In the present example embodiment, the organic layer 370 is patterned to form a column spacer 430a.

A position of the column spacer 430a corresponds to that of the auxiliary contact hole 810. In FIG. 2, no material such as an organic layer is interposed between the column spacer 430a and the pixel electrode 410.

As described above, when the column spacer 430a is formed on the auxiliary contact hole 810, the transmissive type LCD apparatus 2000 may prevent an opening ratio from

being lowered due to the column spacer 430a. Also, the transmissive type LCD apparatus 2000 may prevent the upper substrate 200 from being pushed down toward the lower substrate 1000 because the column spacer 430a is formed on the pixel electrode 410.

FIG. 3 is a cross-sectional view showing a transmissive type LCD apparatus according to another exemplary embodiment of the present invention. In FIG. 3, the same reference numerals denote the same elements in FIG. 2, and thus the detailed descriptions of the same elements will be omitted.

Referring to FIGS. 1 and 3, the lower substrate 1000 includes a gate line 131 and an auxiliary electrode line 145 including aluminum (Al), aluminum alloy, molybdenum (Mo), molybdenum-tungsten alloy (MoW), chromium (Cr) and tantalum (Ta).

In the present example embodiment, an auxiliary capacitor is formed through a previous gate method.

In the previous gate method, a previous gate line that is adjacent to the gate line 131 functions as a first auxiliary electrode 140, and the data line 230a is branched to form a second auxiliary electrode 230b. Thus, the first and second auxiliary electrodes 140 and 230b function as the auxiliary capacitor.

That is, the gate insulating layer 170 is interposed between the first auxiliary electrode 140 and the second auxiliary electrode 230b to form the auxiliary capacitor compensating a capacitance of a liquid crystal capacitor.

When the upper substrate 200 is combined with the lower substrate 5000, a spacer is used to maintain a cell gap. In the present example embodiment, the organic layer 370 is patterned to form a column spacer 430a.

A position of the column spacer 430a corresponds to that of the auxiliary contact hole 810. In FIG. 2, no material such as an organic layer is interposed between the column spacer 430a and the pixel electrode 410.

As described above, when the column spacer 430a is formed on the auxiliary contact

hole 810, the transmissive type LCD apparatus 2000 may prevent an opening ratio from being lowered due to the column spacer 430a. Also, the transmissive type LCD apparatus 2000 may prevent the upper substrate 200 from being pushed down toward the lower substrate 1000 because the column spacer 430a is formed on the pixel electrode 410.

FIGS. 4A to 4F illustrate a method of manufacturing an LCD apparatus shown in FIG. 2.

Referring to FIG. 4A, a metal layer, for example, such as aluminum or aluminum alloy, deposited on an insulating substrate 100 is patterned through a first mask process to form a first auxiliary electrode 140. The first auxiliary electrode 140 that is a previous gate electrode functions as an auxiliary capacitor between a pixel and the previous gate electrode.

Referring to FIG. 4B, a metal layer containing chromium (Cr), molybdenum (Mo), tantalum (Ta) or antimony (Sb) is deposited on the insulating substrate 100 on which the auxiliary electrode 140 is formed, and is patterned through a second mask process to form a gate electrode 110 and a gate pattern 131 and 110. The gate pattern 131 and 110 completely covers the auxiliary electrode 140. The gate electrode 110 is branched from the gate pattern 131 and 110, and formed on a corner of each of pixels arranged in a matrix shape.

Referring to FIG. 4C, a first inorganic material such as silicon nitride or silicon oxide, an intrinsic semiconductor, for example, such as pure amorphous silicon, and an extrinsic semiconductor doped with impurities are successively deposited on the substrate having the gate electrode 110 thereon. The first inorganic insulating material forms a gate insulating layer 170. Then, the extrinsic and intrinsic semiconductors are sequentially patterned through a third mask process to form a semiconductor layer 320 and an active layer 330.

Referring to FIG. 4D, a metal layer containing chromium is deposited over the substrate 100 having the active layer 330 thereon, and patterned through a fourth mask process to form a source electrode 230, a drain electrode 310, an auxiliary electrode 140 and

a source line. The drain electrode 310 is used as a mask to divide the active layer 320 into two parts. The active layer 330 makes an ohmic contact with the source electrode 230, the source line and the drain electrode 315. A second auxiliary electrode 230b that is branched from the data line is overlapped the first auxiliary electrode 140 to interpose the gate insulating layer 170, thereby functioning as the auxiliary capacitor to compensate a capacitance of a liquid crystal capacitor.

Referring to FIG. 4E, an organic layer 370 containing an organic insulating material, for example, such as benzocyclobutene, is formed over the insulating substrate 100 on which the source electrode is formed. The organic layer 370 is patterned through a fifth mask process to form an auxiliary contact hole 810, thereby partially exposing the auxiliary electrode 140.

Referring to FIG. 4F, an indium tin oxide (ITO) is deposited on the organic layer and patterned through a sixth mask process to form a pixel electrode. The pixel electrode 410 is electrically connected to the drain electrode 310 through the drain contact hole 710, and is electrically connected to the auxiliary electrode 140 through the auxiliary contact hole 800. Thus, although an electric charge stored in the pixel electrode 410 is decreased by passing time, the auxiliary capacitor compensates the capacitance.

As shown in FIG. 2, a column spacer 430a is formed corresponding to the auxiliary contact hole 800. Any material such as an organic layer is not interposed between the column spacer 430a and the pixel electrode 410.

Alternatively, as shown in FIG. 3, the column spacer 430b is formed corresponding to the auxiliary contact hole 800 that is an opening of the auxiliary contact hole 800 to be supported by the pixel electrode 410. Thus, any material such as an organic layer is not interposed between the pixel electrode 410 and the column spacer 430b.

As described above, when the column spacers 430a and 430b are formed on the position corresponding to the auxiliary contact hole 800, the LCD apparatus may prevent an

opening ratio from being lowered due to the column spacers 430a and 430b. Also, the LCD apparatus may prevent the upper substrate 200 from being pushed down toward the lower substrate 200 because the column spacer 430a is formed on the pixel electrode 410.

[EFFECT OF THE INVENTION]

According to the LCD apparatus and the method of manufacturing the LCD apparatus of the present invention, a column spacer is disposed on a portion corresponding to an auxiliary contact hole. Thus, image display quality of the LCD apparatus is improved.

Although the exemplary embodiments of the present invention have been described, it is understood that the present invention should not be limited to these exemplary embodiments but various changes and modifications can be made by one ordinary skilled in the art within the spirit and scope of the present invention as hereinafter claimed.

[CLAIMS]

[CLAIMS 1]

An LCD apparatus comprising:

a lower substrate including:

an insulating substrate;

a gate line formed on the insulating substrate and extended in a first direction, the gate line having a gate electrode branched therefrom;

a gate insulating layer for covering the gate line;

an auxiliary capacitor including first and second auxiliary electrodes spaced apart from each other by the gate insulating layer;

a protecting layer covering the auxiliary capacitor;

a data line formed between the gate insulating layer and the protecting layer and extended in a second direction substantially perpendicular to the first direction, the data line having a source electrode and a drain electrode branched therefrom;

an auxiliary contact hole formed through the protecting layer to partially expose the second auxiliary electrode; and

a pixel electrode formed on the protecting layer and electrically connected to the drain electrode by means of the second auxiliary electrode;

an upper substrate facing the lower substrate, the upper substrate having a spacer disposed corresponding to the auxiliary contact hole so as to uniformly maintain a cell gap between the lower and upper substrates; and

a liquid crystal interposed between the lower and upper substrates.

[CLAIMS 2]

The LCD apparatus of claim 1, wherein the pixel electrode comprises indium tin oxide or indium zinc oxide.

[CLAIMS 3]

The LCD apparatus of claim 2, wherein the first auxiliary electrode is a previous gate line adjacent to the gate line, and the second auxiliary electrode is branched from the data line.

[CLAIMS 4]

A method of manufacturing an LCD apparatus, comprising:

preparing a lower substrate including:

forming a first auxiliary electrode on an insulating substrate;

forming a gate electrode on the insulating substrate;

forming a gate insulating layer over the first auxiliary electrode and the gate electrode;

forming a semiconductor layer on the gate insulating layer corresponding to the gate electrode;

forming source-drain electrodes on the semiconductor layer;

forming a second auxiliary electrode on the gate insulating layer corresponding to the first auxiliary electrode;

forming the protecting layer covering the auxiliary capacitor; and

forming an auxiliary contact hole through the protecting layer to expose the second auxiliary electrode;

preparing an upper substrate combined with the lower substrate;

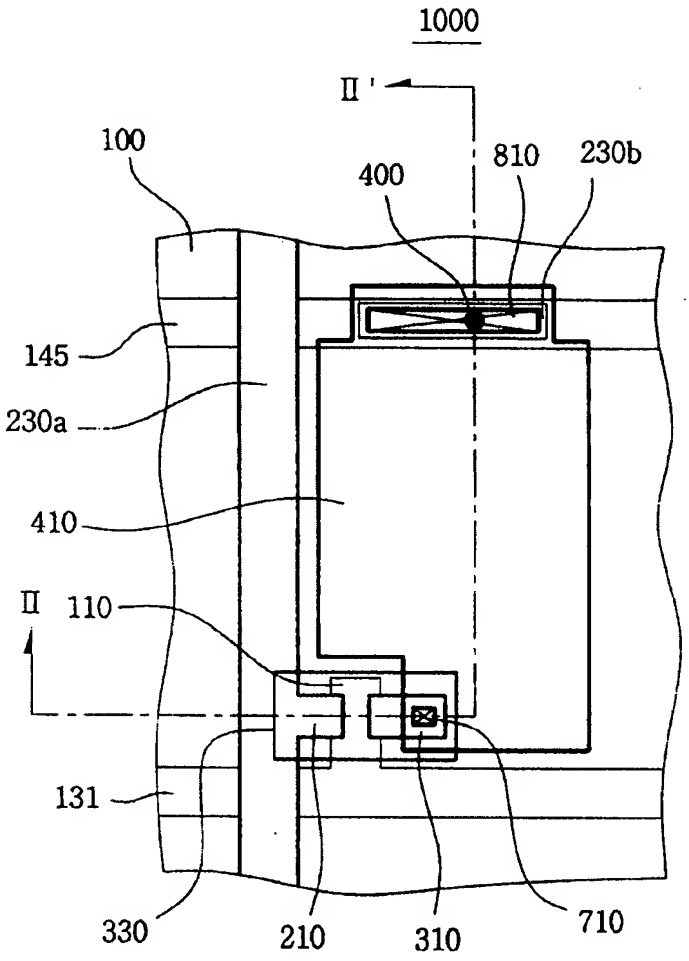
forming a spacer disposed corresponding to the auxiliary contact hole so as to uniformly maintain a gap between the lower and upper substrates; and

interposing a liquid crystal between the lower and upper substrates,

wherein the first auxiliary electrode is a previous gate line adjacent to a gate line, and the second auxiliary electrode is branched from the data line.

[DRAWING]

[FIG.1]



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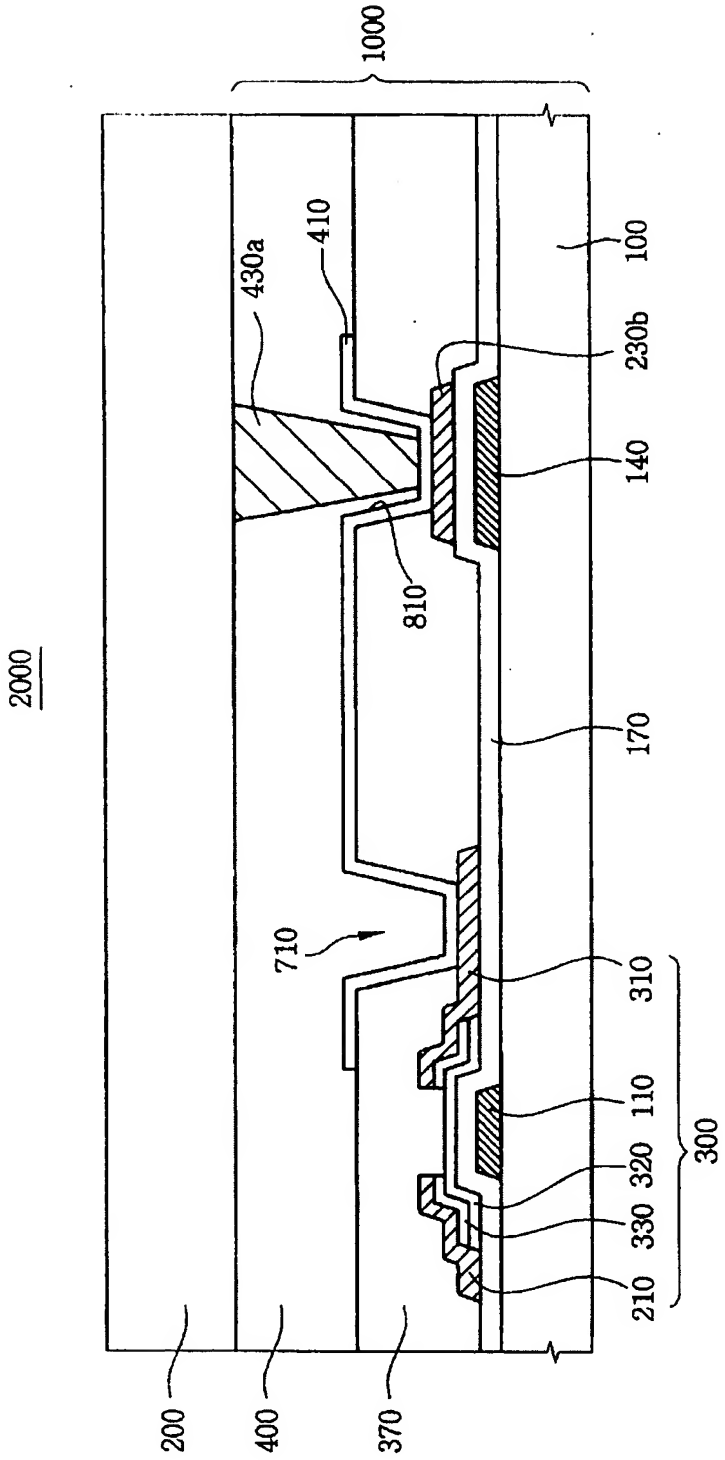
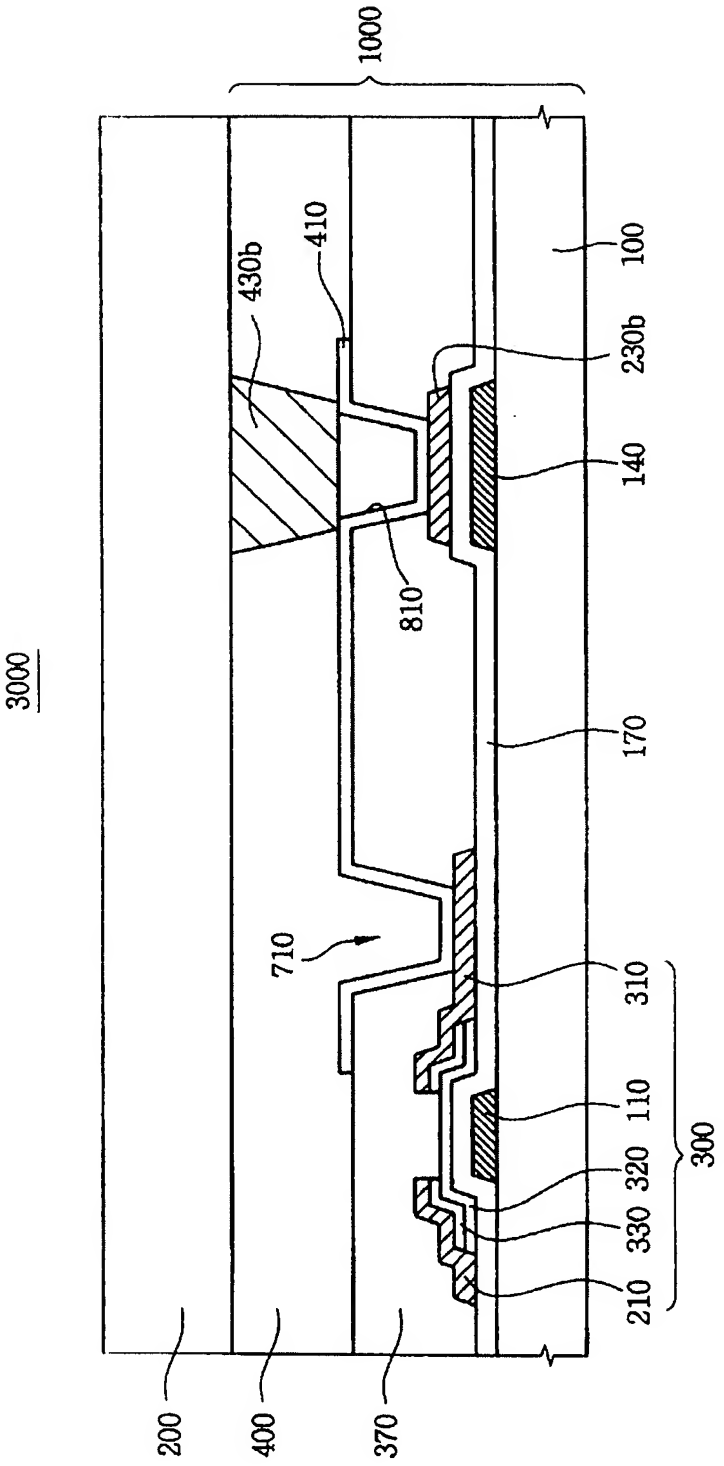
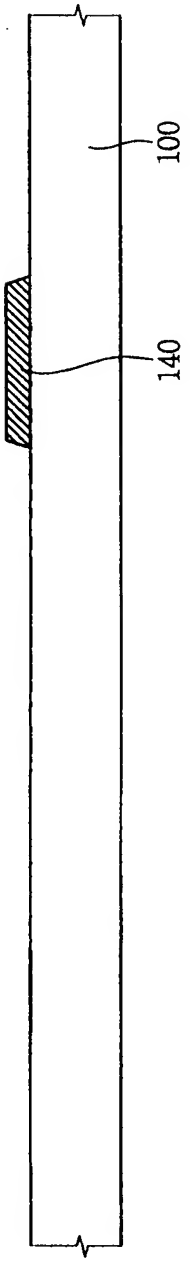
[FIG.2]



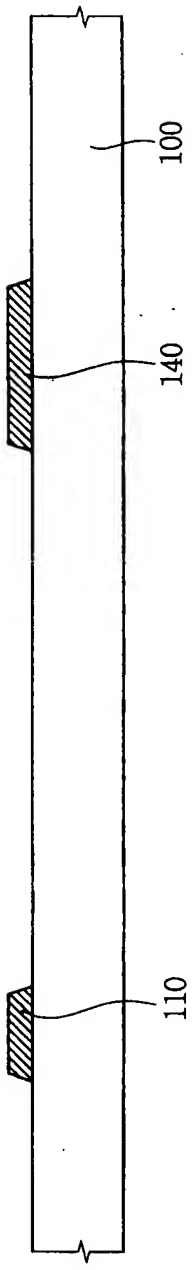
[FIG.3]


3000
1000
430b
410
100
230b
140
810
170
710
310
110
320
330
210
300
200
400
370

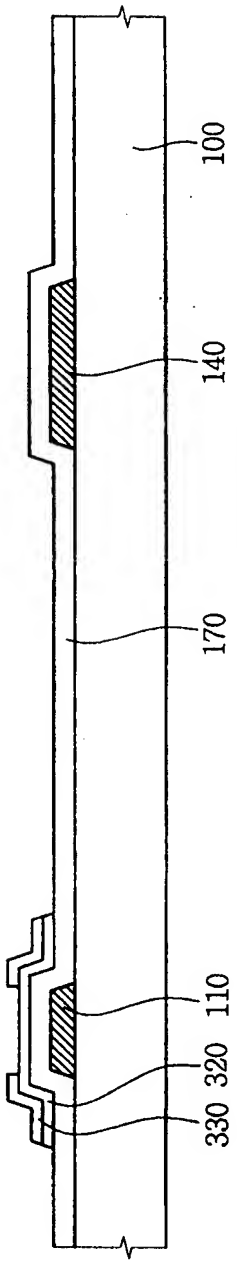
[FIG4A]



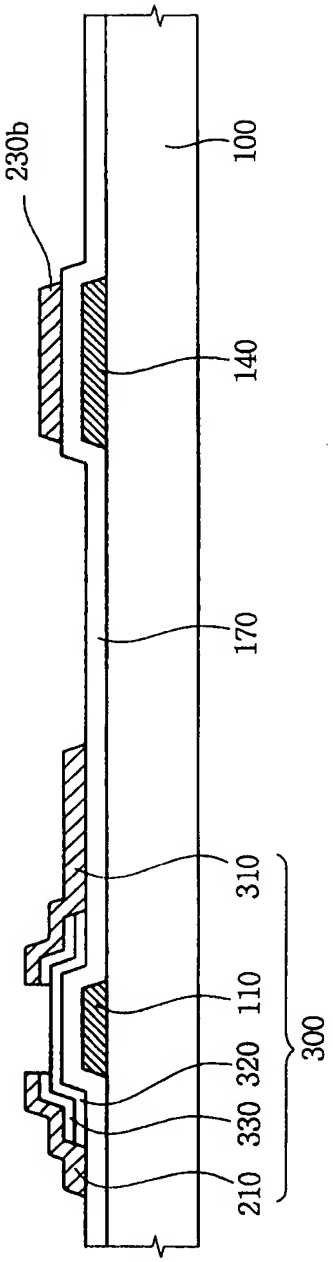
[FIG4B]



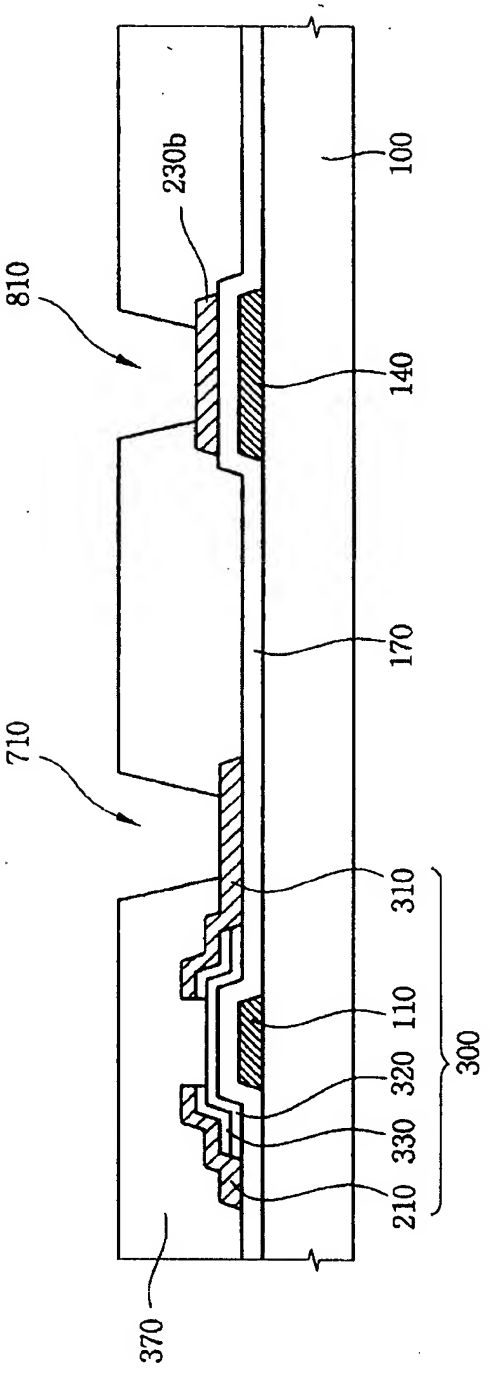
[FIG.4C]



[FIG4D]



[FIG4E]



[FIG4F]